PATENT SPECIFICATION 908,127

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in or relating to Conduit Pipe.

We, COLUMBIA PRODUCTS COMPANY, a Corporation organized under the laws of the State of South Carolina, one of the United States of America, of the City of Columbia, State of South Carolina, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pipe sections for use as conduit for electrical wiring and the like. More particularly, it relates to such pipe sections made of fibreglass.

On straight-run electric wiring installations, it is desirable to protect the wire from damage by impact or by the elements by passing the wire through, and encompassing the wire in conduit, which conduit is normally in the form of joined pipe sections, or lengths. Conduit used for above-ground installations is usually of metal, such as steel, whereas conduit placed underground is usually of other materials, such as concrete, ceramic tile, or one of several presently available compound or pressed materials. The present invention, primarily for reasons of economy, may find more general acceptance for underground use for reasons which will be hereinafter explained, but it is to be understood that its many advantages may be obtained when used above ground.

Conduit used in underground electrical installations must remain serviceable for a relatively long duration of time under sometimes unpredictable conditions. It must be non-corrosive, chemically inert, and non-porous to prevent the filtering-in of water. The material used must be suitable for forming watertight joints between the sections, and must be strong to withstand crushing forces due to earth and other loads located over it. Furthermore, the material should not be brittle in nature because the conduit must possess qualities of resiliency, to resist impact of, for example, earth and rocks during the back-filling operation, and flexibility, to accommodate unpredictable changes in load conditions as by temperature changes, causing expansion and contraction, and by earth settling or shifting, causing changes in the locations and areas of conduit support, and by conditions of vibration emanating from above or within the ground caused by machinery, the movement of surface vehicles, subways and the like. Breakage of the conduit under load could cause rupture of the electric wire contained therein, and even a crack through the conduit wall could cause seepage of underground water into manholes at the ends of the run of conduit, as well as into contact with the wire, an obvious electrical hazard. Furthermore, the materials heretofore used often have abrasive qualities necessitating shorter runs of conduit because of the difficulty of pulling wire therethrough, and sometimes causing undiscovered damage to the wire during the pulling operation.

Because of the brittle nature and other qualities of materials heretofore used for underground pipe conduit, the wall thickness of the pipe sections has been relatively large chiefly to withstand bending and crushing forces. Much expenditure of time and mortar materials is usually required to effect a water-tight seal at the joints between pipe sections because of the inadaptability of the material to the formation of close, slide-type fits between the sections. Close fits require maintaining close toler-

ances of size during manufacture of the sections, heretofore difficult to achieve. Where end portions of the sections are made in male and female fashion for direct connection with one another, the abrupt changes in shape required at the end portions establishes points or areas of sectional weakness in the conduit.

Fibreglass is known to be non-corrosive, chemically inert, non-porous, resilient, capable of producing a smooth surface, and possessing great compressive and tensile strength. But, heretofore, it has not been understood how a uniform conduit section can be made of fibreglass so that points or areas of sectional weakness will not be developed at male and female end portions, and further so that close, slide-type fits between the sections can be achieved where that type of joint is desired.

It is therefore, an object of this invention to provide a conduit section made of fibreglass.

According to the present invention there is provided a pipe or conduit section suitable, for example, for encompassing and protecting electric wire and the like, having integrally formed female and male end portions and comprising an interior layer of helically-wound resin impregnated glass fibres of which at least some are circumferentially-extending in a manner substantially at right angles to the axis of the conduit, an intermediate layer of longitudinally-extending resin impregnated glass fibres, and an outer layer of helically-wound resin impregnated glass fibres, the said circumferentially-extending fibres having lateral variations of concentration at and/or near at least the said female end portion to form said female end portion and to permit said intermediate layer to be continuous and substantially straight throughout the length of said conduit section, the said variations of concentration of fibres and the said intermediate layer co-operating to provide substantially uniform strength throughout the said conduit section.

In order that the invention may be more clearly understood and readily carried into effect the same will now be described more fully with reference to the accompanying drawings in which:—

Figure 1 shows generally a conduit section made in accordance with the invention;

Figure 2 is a perspective view partially broken away showing a central portion of a conduit section made in accordance with the invention;

Figure 3 is a sectional side elevation to show a preferred form in which corresponding male and female end portions of the pipe section may be made in accordance with the invention;

Figure 4 is a sectional side elevation of corresponding male and female end portions to show a modified form of the invention; and

Figure 5 is a sectional side elevation of corresponding male and female end portions to show still another modified form of the invention.

In general, a conduit of the invention consists of a hollow conduit section 1 having fibreglass elements, as will be described. The conduit section 1 is of uniform diameter throughout the major part of its length as at 2, and has both a male end portion 3 and a female end portion 4 corresponding in size and shape for close-fitting, slide-type connection of one section with another.

The conduit section 1 has, for a purpose to be described, an interior layer 5 of helically wound glass fibres, each fibre being bonded to contiguous fibres by a bonding agent such as diallyl phthalate resin. Some of the fibres of the inter layer 5 are wrapped so as circumferentially to extend substantially at right angles to the axis of the conduit, for reasons to be explained, but it is to be understood that, at least at the central portion 2, the helix of fibres may be pitched at other angles relative to the axis of the conduit section 1 without departing from the invention.

Superposed about interior layer 5, and bonded thereto by a bonding agent such as diallyl phthalate resin, is an intermediate layer 6 of longitudinally-extending glass fibres, and fibres in the layer 6 each being also bonded to contiguous fibres by the said bonding agent. The longitudinally-extending fibres serve as tension and compression members to resist bending forces acting on the finished conduit section. Since they are the main strength members of the section, it is preferred that the intermediate layer 6 of glass fibres be somewhat greater in wall-thickness than the helically wound layers. However, the wall-thickness of intermediate layer 6 will be determined by the strength requirements of the finished conduit section, so that any suitable wall-thickness of said intermediate layer is within the contemplation of the invention.

Superposed about intermediate layer 6, and also bonded thereto by a bonding agent such as diallyl phthalate resin, is an outer layer 7 of helically-wound glass fibres, each fibre being also bonded to contiguous fibres by the said bonding agent. It is preferred that the outer layer 7 also be wrapped so that the fibres thereof extend substantially at right angles to the axis of the conduit, for reasons to be described, but it is to be understood that the helix of fibres may be

pitched at other angles relative to the axis of the conduit section 1 without departing from the invention.

To assist the curing action of the resin impregnated glass fibres, a coating 8 of curing resin, such as a resin having a styrene base, surrounds the outer layer 7. Such coating of curing resin will facilitate curing of the finished conduit section in air when heat is applied.

Male end portion 3 and female end portion 4 are formed integrally with the portion 2 on a mandrel. Using mandrel-forming, a lateral variation of concentration, or building-up is achieved of layers of fibres circumferentially-extending in a manner substantially at right angles to the axis of the conduit. Such variation of concentration of fibres of interior layer 5 at formed shoulders on the mandrel will impart, to the female end portion, the requisite shape, and such variation of concentration of fibres of outer layer 7 will impart to the male end portion the requisite shape. Figures 3, 4 and 5 show several manners of varying the concentration of circumferentially-extending fibres to form several suggested configurations of corresponding male and female end portions of the invention to provide matched joints between sections and continuous, uniform interior surfaces in a run of conduit sections. It is to be understood, however, that other configurations may be made without departure from the invention.

Figure 3 shows the end portions of a conduit section, in matching relation as when one section is to be joined to another, with a straight interior female end portion 4 having an interiorly located shoulder portion 9 corresponding in depth to the wall-thickness of the straight male end portion 3. The male end portion is substantially a continuation of the central section 2 having substantially the same cross-section. Male end portion 3 may, however, require a small amount of machining or sanding down of the thin coating 8 of styrene resin on the outer surface thereof, to perfect the matching fit of the end portions.

Figure 4 shows matching end portions of a conduit section with a tapered interior female end portion 4 having no shoulder portion thereinside. Male end portion 3 is shaped with a corresponding taper, and has exteriorly located shoulder portion 10.

Figure 5 shows matching end portions of a conduit section with a tapered interior female end portion 4 having an interiorly located shoulder portion 9 and a correspondingly tapered male end portion 3 having no exteriorly located shoulder portion.

The fibres which are circumferentially-extending in a manner substantially at right angles to the axis of the conduit of the interior and outer layers of conduit section 1 serve to reinforce and to prevent separation of the longitudinally extending fibres of intermediate layer 6. Because separation of the longitudinally-extending fibres will generally occur in the direction of the circumference of the conduit section, and for other reasons to be hereinafter explained, the direction of wrapping of some of the fibres of the interior and outer layers is substantially at right angles to the axis of the conduit.

Winding of the fibres of layers 5 and 7 in this manner facilitates formation on a mandrel of the male and female end portions by permitting accurate placing of the concentrations of the fibres of these layers at shoulder portions 9 and 10. Helical winding at a relatively large pitch angle over the central portion 2 would require changing of the pitch of winding at these shoulder portions. Circumferential winding, substantially at right angles to the axis of the conduit, of the fibres of outer layer 7 facilitates manufacture of the pipe conduit section by permitting the fibres to be wrapped at the same rate of winding as the fibres of interior layer 5.

Because of the configuration of the lateral concentration of fibres at shoulder portions 9 and 10 in the respective embodiments, the longitudinally-extending fibres of intermediate layer 6, which is the layer providing the main strength of the pipe conduit section, are permitted to be continuous over substantially the entire length of the section and in substantially straight arrangement at the male and female end portions. The building-up or lateral concentration of the fibres of the interior layer 5 can be tapered to a fair curve at the surface thereof upon which the longitudinally-extending fibres are disposed. The continuity and substantial straightness of the longitudinally-extending fibres, being void of breaks and sharp curves, materially contributes to the cross-sectional strength of the finished pipe conduit section at the areas of formation of the male and female end portions. While it may be necessary to curve slightly the longitudinally-extending fibres in order to form the desired shape of the male and female end portions, the said slight curvature therein is fully supported at all points by the fibres of the circumferentially-wound interior and exterior layers, the lateral concentrations of the fibres in those layers being varied for the purpose.

Mandrel-forming on a mandrel made of, say, steel and having a smooth surface will not only facilitate formation of sharp shoulder portions and tapers without the necessity for machinery at the male and female end portions, but will also impart a very smooth interior surface throughout the entire length of the conduit section. A rela-

tively smooth interior surface in conduit is highly desirable for the reduction of frictional forces between the wires and the said interior surface during the wire-pulling operation, as aforesaid, making possible the avoidance of damage to the wires as well as making feasible relatively long runs of conduit sections between, usually, manhole stations at each end of the underground run. Fewer manhole installations will be normally required thereby effecting economy of installation of underground conduit, and, correspondingly the pipe sections themselves may be made longer (for example, about 10" long), reducing the number of joints between sections of the run of conduit.

The close-fitting slide-type fits between conduit sections made possible by the availability of close tolerance manufacture of each section by mandrel-forming effects still further economies in labour required during installation. Instead of the usual careful mortaring of the joints which is presently required, the closely fitting male and female end portions require merely a simple application of a thin coating of resin, or cement, or other bonding material at the end portions before making the connections.

Thus, a new and useful structure for use in making fibreglass conduit sections has been set forth which avoids the necessity for machining end portions to form the joint, which machining usually will destroy the continuity of the fibres, resulting in reduced cross-sectional strength in the finished conduit section. The novel structure which has been described can be easily achieved by the use in manufacture of a smooth mandrel, having shoulders and tapers formed thereon. By the use of such structure, advantage may be taken of the inherent properties of fibreglass, including its strength, to make fibreglass conduit sections having relatively small wall-thickness ($^3/_{16}$" wall-thickness in a 4" diameter pipe, for example), as well as other qualities necessary in underground conduits.

It is to be understood, however, that while the invention contemplates use of such structure in the manufacture of electrical conduit, it may also be used in manufacturing pipe sections for other purposes without departing from the principle of the invention.

WHAT WE CLAIM IS:—

1. A pipe or conduit section suitable, for example, for encompassing and protecting electric wire and the like, having integrally formed female and male end portions and comprising an interior layer of helically-wound resin impregnated glass fibres of which at least some are circumferentially-extending in a manner substantially at right angles to the axis of the conduit, an intermediate layer of longitudinally-extending resin impregnated glass fibres, and an outer layer of helically-wound resin impregnated glass fibres, the said circumferentially-extending fibres having lateral variations of concentration at and/or near at least the said female end portion to form said female end portion and to permit said intermediate layer to be continuous and substantially straight throughout the length of said conduit section, the said variations of concentration of fibres and the said intermediate layer co-operating to provide substantially uniform strength throughout the said conduit section.

2. The conduit section according to Claim 1 in which the conduit section is formed on a mandrel and has a smooth interior surface conforming in shape to that of said mandrel, the integrally formed male end portion corresponding dimensionally with the female end portion for relatively close fit when joining together a plurality of the conduit sections.

3. The conduit section according to Claim 2 in which the female end portion is straight and has an interiorly located shoulder portion conforming in shape to a shoulder on the mandrel, the male end portion is straight and corresponds dimensionally with the female end portion for providing the relatively close fit, and including a central portion formed integrally with the female and male end portions, the fibres of the interior layer having the lateral variations of concentration to shape the female end portion and to form the interiorly located shoulder portion.

4. The conduit section according to Claim 2 in which the female end portion is tapered and conforms in shape to a taper on the mandrel, the male end portion is tapered and has an exteriorly located shoulder portion and corresponds dimensionally with the female end portion to provide the relatively close fit, and including a central portion formed integrally with the female and male end portions, the lateral variations of concentration of the fibres of the interior layer near the end portions shapes the end portions and supports the longitudinally extending fibres to permit the intermediate layer to be continuous and substantially straight throughout the length of the conduit section, and the fibres of the outer layer have lateral variations of concentration at least at and to shape the male end portion and to form the exteriorly located shoulder portion.

5. The conduit section according to Claim 2 in which the female end portion is tapered and conforms in shape to a taper on the mandrel and has an interiorly located shoulder portion conforming in shape to a shoulder on the mandrel, a tapered male end

portion corresponding dimensionally with the female end portion for relatively close fit when joining together a plurality of the conduit sections, and including a central portion formed integrally with the male and female end portions, the fibres of the interior layer having lateral variations of concentration at and near the end portions to shape the end portions and to form the interiorly located shoulder portion.

6. A conduit section according to any one of the preceding claims in which the fibres in each layer are impregnated with a diallyl phthalate resin and a coating of styrene based curing resin is disposed on the outer layer.

7. A conduit section for encompassing and protecting electric wire and the like having its parts constructed and arranged substantially as hereinbefore described with reference to the accompanying drawings.

8. A conduit composed of two or more of the conduit sections of any one of the preceding claims.

HASELTINE, LAKE & CO.,
28 Southampton Buildings,
London, W.C.2,
Agents for the Applicants.

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908,127 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

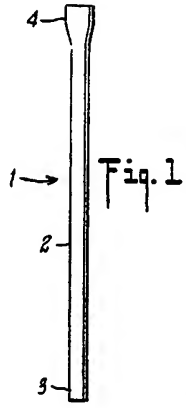


Fig. 1.

Fig. 2.

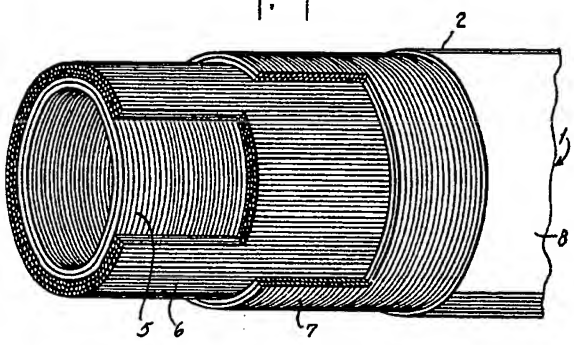


Fig. 3.

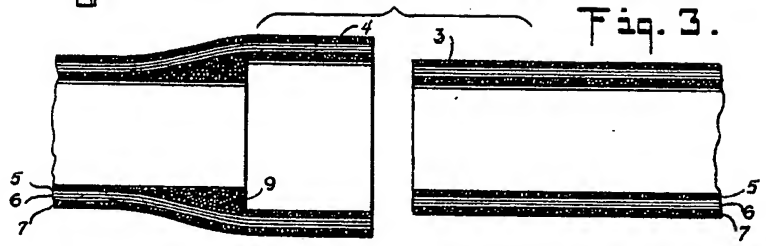


Fig. 4.

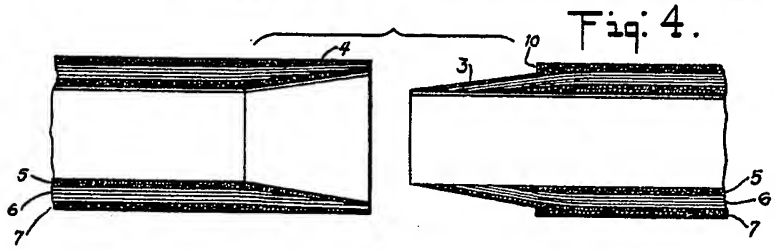
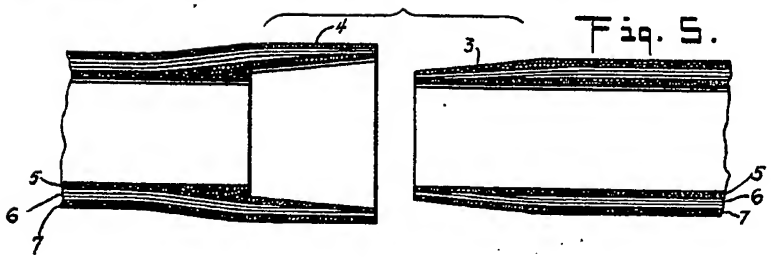


Fig. 5.



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APPLICANT: A. Hasslberger et al.

LERNER AND GREENBERG P.A.
P.O. BOX 2480
HOLLYWOOD, FLORIDA 33022
TEL. (954) 925-1100